Space Weather Technical Forecast

Issued on Wednesday, 29 March 2023 at 00:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of reaching G1/Minor Storm from late Day 2 (30th) into Days 3 and 4 (31st March and 1st April). Chance of Active electron fluence on Day 1 (29th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only minor C-class flares. There are currently seven sunspot regions on the visible disc. AR3256 in the southwest remains the largest and most magnetically complex region, continuing to evolve in the trailer portion. AR3263 and AR3265, both located in the northwest quadrant, have also shown some growth within their intermediate spot regions. There are three new and currently unnumbered sunspots on the disc, these appear to be stable and magnetically simple. All other active regions on the disc also appear to be stable and magnetically simple, with only minor fluctuations in areal extent. No Earth-directed CMEs were observed in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by ACE, was mostly at background levels, but briefly returned to slightly elevated levels, with speeds ranging between 350 and 450km/s. Density was below average. The IMF (Bt) was weak, around 5-6nT, throughout the period, with the north-south component (Bz) also weak, varying between +2/-5nT. The net result of the above solar wind measures was for mostly Quiet (Kp 0-2) geomagnetic activity.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 remained at Background levels. The high energy electron flux (greater than 2MeV) measured at GOES16 was at Moderate to High levels, with a peak of 1813 pfu observed at 28/1420 UTC. The associated 24-hour fluence remained just below the Active (1e8 integrated pfu) threshold, with an overall rising trend. At 29/0001 UTC the observed fluence was 8.21e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to remain Low, but with a Chance of becoming Moderate with any isolated M-class flares. The main region likely to give such flares is AR3256 in the southwest.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast. Solar winds are expected to remain at slow-ambient levels until the next coronal hole CH88/- becomes geoeffective, possibly arriving late on day 2 (30th), and continuing into days 3 and 4 (31st March and 1st April). Initially Quiet (Kp 0-2) with slight chance of Unsettled interval (Kp 3) during day 1 (29th) and into day 2 (30th). Later on day 2 (30th) and into days 3 and 4 (31st March to 1st April), we are likely to see the arrival of a CIR ahead of the fast wind from CH88/-. Geomagnetic activity is likely to increase to Unsettled with Active intervals with a Chance of G1/Minor geomagnetic storms.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is

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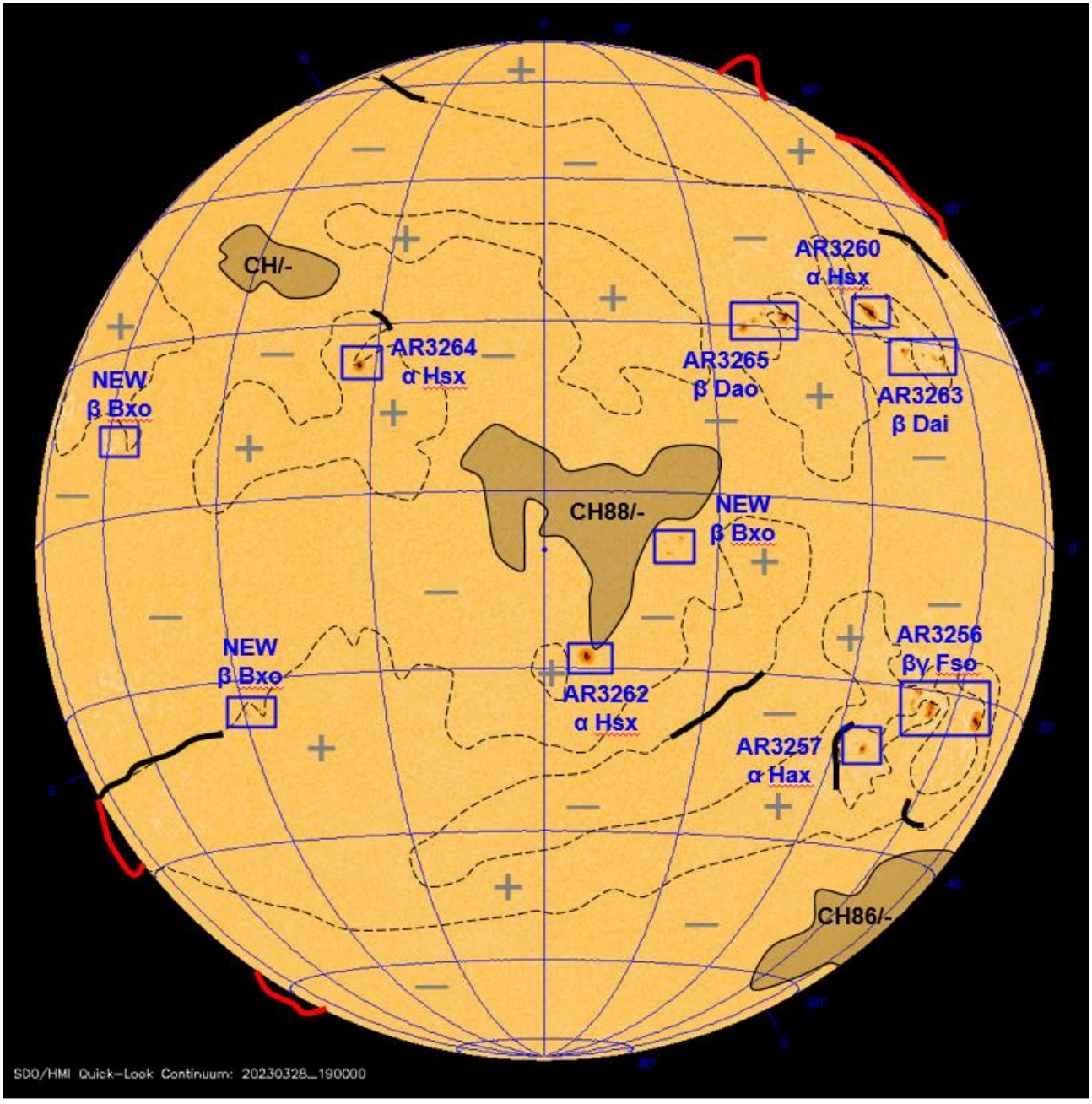
expected to remain at Background levels, but with a Slight Chance of reaching S1 or greater, should any significant flares occur.

The high energy (greater than 2 MeV) electron flux is currently Moderate to High and is likely to peak at High levels during day 1 (29th), possibly extending into day 2 (30th). The associated 24-hour fluence is expected to initially continue on an upward trajectory, with Active (1e8 integrated pfu) conditions likely day 1 (29th), probably easing by days 2 and 3 (30th and 31st) before the arrival of the next HSS from CH88/-.

Figure 1. Solar Analysis Valid 28/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

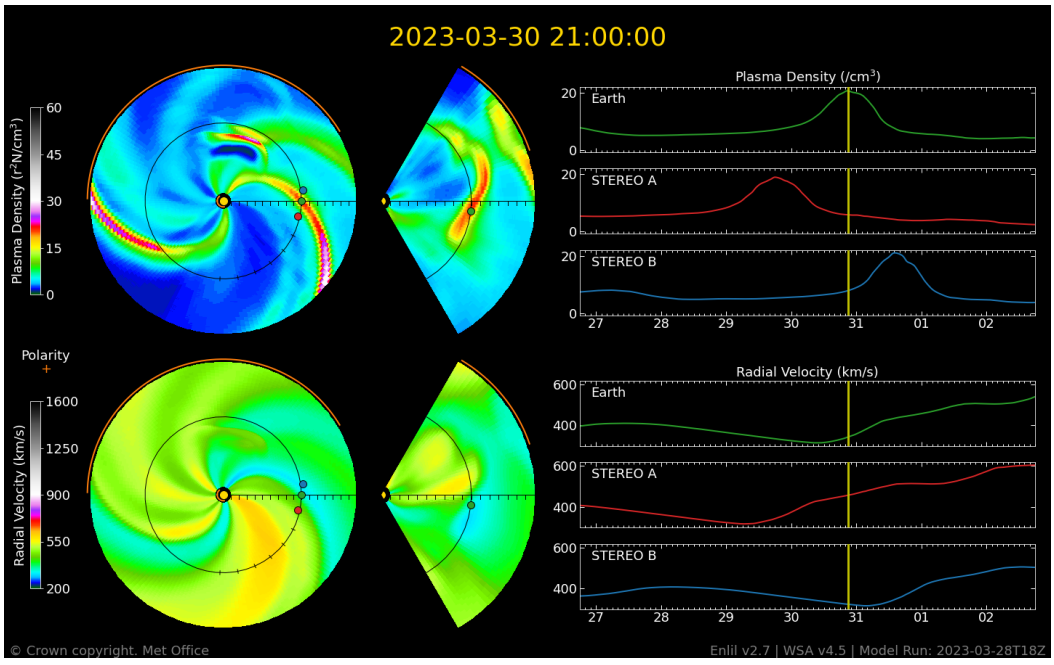
No Earth-directed CMEs currently feature in the forecast.

Solar winds are currently at slow-ambient levels, which are expected to remain at this level during day 1 (29th) and into day 2 (30th). The next coronal hole expected to impact Earth is CH88/-. This appears slightly further west than the previous rotation so it's possible we may see its HSS and possibly CIR late on day 2 (30th), before entering into the HSS on day 3 (31st), with speeds likely to reach up to 500-550km/s.

Quiet to Unsettled (Kp 0-3) geomagnetic activity is expected on day 1 (29th) and into day 2 (30th). Later on day 2 (30th) and into day 3 (31st), we are likely to see a CIR arrive ahead of the HSS from CH88/-, which will increase geomagnetic activity to Unsettled (Kp 3) with Active (Kp 4) intervals, and a Chance of G1/Minor (Kp 5) geomagnetic storms. The effects of the HSS from CH88 are likely to continue through day 4 (April 1st).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	30	40	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil – shows arrival of the next fast wind from CH88 late 30th into 31st March.



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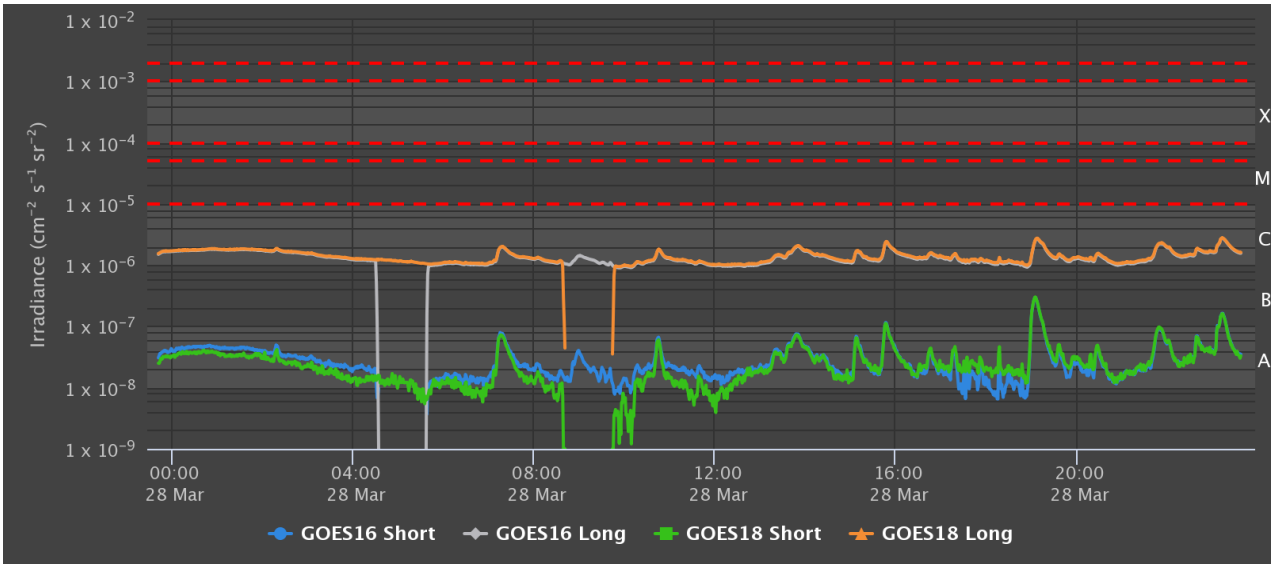
Radio Blackouts - X-Ray Flares:
Solar activity has been Low over the past 24 hours, with occasional minor C-Class flares.

There are currently seven sunspot regions on the visible disc. AR3256 in the southwest remains the largest and most magnetically complex region, continuing to evolve in the trailer portion. AR3263 and AR3265, both located in the northwest quadrant, have also shown some growth within their intermediate spot regions.The other active regions appear stable and magnetically simple, with only minor fluctuations in areal extent.

Solar activity is most likely to remain Low, but with a Chance of becoming Moderate with any isolated M-class flares. The main region likely to give such flares is AR3256 in the southwest.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES X-Ray flares.



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES16 is currently at Background levels.

Proton flux is most likely to remain at Background levels, with a very slight chance of reaching S1 or greater should any larger flares or significant CMEs occur.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is at Moderate to High levels. There is considered a reasonably strong potential for further day-on-day increases in flux during day 1 (29th), possibly extending into day 2 (30th) of the four-day forecast period. The 1000pfu High threshold is likely to be breached at diurnal maximum each day in the expected absence of further significant geomagnetic activity.

There is a slight chance of the Active 24-hour integrated electron fluence being realised on day 1 (29th March), perhaps into day 2 (30th). However, this reduces by days 3 and 4 (March 31st and 1st April) as Earth enters a High Speed Stream (HSS) from CH88/-.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	80	60	40	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM electron fluence

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